

PUBLIC SENTIMENT TOWARDS MANDATORY HALAL CERTIFICATION: A LARGE LANGUAGE MODEL (LLM) APPROACH

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Abstract

This study analyzes public sentiment towards mandatory halal certification in Indonesia, as mandated by Law No. 33/2014 and its revision in Government Regulation No. 39/2021. Using the Large Language Model (LLM) approach, sentiment analysis was conducted on a dataset consisting of 320 samples of headlines from various electronic media platforms, published between 2019 and 2023. The LLM model, employing the RoBERTa architecture, was trained on an Indonesian language dataset and optimized for sentiment classification tasks. Data preprocessing included web scraping, data cleansing, and text vectorization using Term Frequency-Inverse Document Frequency (TF-IDF) techniques and cosine-similarity. The model demonstrated a confidence score of the classifications mean of 87.35% and median 96.12% in classifying the news headlines. Results revealed a predominant positive sentiment (57%) towards halal certification, indicating public awareness of its significances. However, negative sentiments (26%) highlighted challenges faced by Small and Medium Enterprises (SMEs), including high costs and lack of understanding about the certification process. The temporal analysis showed an increase in halal-related news coverage following the implementation of new regulations. This study contributes to the understanding of public perception towards regulatory changes in the halal industry and demonstrates the effectiveness of LLM-based sentiment analysis in comprehending public opinions. The findings provide valuable insights for policymakers and businesses in addressing the potential and challenges in implementing mandatory halal certification.

Keywords: Halal Certification, Sentiment Analysis, Large Language Model, Data Science

Abstrak

Studi ini menganalisis sentimen publik terhadap kewajiban sertifikasi halal di Indonesia, sebagaimana diamanatkan oleh UU No. 33/2014 dan revisinya dalam Peraturan Pemerintah No. 39/2021. Dengan menggunakan pendekatan Large Language Model (LLM), analisis sentimen dilakukan terhadap dataset yang terdiri

Adhi Rahmadian

Public Sentiment Towards Mandatory Halal Certification: A Large Language Model (LLM) Approach

dari 320 sampel berita utama dari berbagai platform media elektronik, yang diterbitkan antara tahun 2019 dan 2023. Model LLM, yang menggunakan arsitektur RoBERTa, dilatih pada dataset bahasa Indonesia dan dioptimalkan untuk tugas klasifikasi sentimen. Prapemrosesan data meliputi web scraping, pembersihan data, dan vektorisasi teks menggunakan teknik Term Frequency-Inverse Document Frequency (TF-IDF) dan cosine-similarity. Model ini menunjukkan nilai kepercayaan dari rata-rata klasifikasi sebesar 87,35% dan median 96,12% dalam mengklasifikasikan berita utama. Hasil penelitian menunjukkan sentimen positif yang dominan (57%) terhadap sertifikasi halal, yang mengindikasikan kesadaran masyarakat akan pentingnya sertifikasi halal. Namun, sentimen negatif (26%) menyoroti tantangan yang dihadapi oleh Usaha Kecil dan Menengah (UKM), termasuk biaya yang tinggi dan kurangnya pemahaman tentang proses sertifikasi. Analisis temporal menunjukkan adanya peningkatan liputan berita terkait halal setelah penerapan peraturan baru. Studi ini berkontribusi pada pemahaman persepsi publik terhadap perubahan peraturan di industri halal dan menunjukkan efektivitas analisis sentimen berbasis LLM dalam memahami opini publik. Temuan ini memberikan wawasan yang berharga bagi para pembuat kebijakan dan pelaku usaha dalam mengatasi potensi dan tantangan dalam menerapkan kewajiban sertifikasi halal.

Kata Kunci: Sertifikasi Halal, Analisis Sentimen, Large Language Model, Data Science

Introduction

The global halal industry has witnessed a surge in attention, prompting an escalation in demand for halal products from both Muslim and non-Muslim consumers (Yusuf et al., 2016). Recent projections indicate that the global Muslim population will reach approximately 1.9 billion by 2024, with the estimated value of the global halal industry standing at USD \$3.67 trillion in 2021 and projected to grow to \$1063.11 trillion by 2030 (Statista.com & GrandViewResearch.com, 2024). This significant growth is driven by the rising demand of halal products in Muslim-majority nations, combined with an increased awareness of the significance of halal certification (Rahmawati et al., 2022).

The halal concept has transcended religious boundaries, evolving into a symbol of quality in the global marketplace. The demand for halal products is

underpinned by the belief that halal food is healthier, safer, and more delectable, enabling the halal concept to attract both Muslim and non-Muslim consumers (Yulia, 2015; Annabi & Ibidapo-Obe, 2017). This perception has expanded the halal market beyond traditionally Muslim-majority countries, making it a significant economic force on a global scale (Wilson & Liu, 2020). For instance, in Japan, a non-Muslim majority country, the number of halal-certified restaurants increased from 54 in 2012 to over 1,000 in 2023, highlighting the growing recognition of halal certification as a mark of quality and safety (Rozaidah & Idris, 2024).

Halal certification serves as a crucial attestation of a product's compliance with Islamic law, covering food, beverages, cosmetics, pharmaceuticals, and other products. The halal industry emphasizes stringent verification and certification processes at every stage of production to ensure the absence of contamination from non-halal materials or processes, employing rigorous analytical techniques (Faridah, 2014). This focus on quality and ethical production has further boosted the appeal of halal products.

On a global scale, the market for certified halal products is being recognized as a food safety standard and quality assurance, encapsulating aspects of Islam, cleanliness, sanitation, and safety (Pohan, 2024). In Indonesia, the world's largest Muslim-majority country, the halal industry plays a crucial role in both domestic consumption and export potential.

The government has mandated halal certification for various product categories based on Law No. 33/2014 and Government Regulation No. 39/2021, covering food, beverages, raw materials, additives, supporting materials, slaughtered products, and slaughtering services. This regulation must be implemented by businesses before October 17, 2024, with sanctions for non-compliance including written warnings, administrative fines, and product withdrawal from circulation (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, 2024).

However, the implementation of mandatory halal certification presents both opportunities and challenges. Although the aim is to ensure product integrity and increase consumer confidence, this puts a new burden on businesses, especially small and medium enterprises (SMEs). Understanding public sentiment towards these regulatory changes is crucial for policymakers to balance religious obligations, consumer protection, and economic growth (Mostafa, 2020).

Sentiment analysis, or opinion mining, is the process of automatically extracting and comprehending sentiments or opinions embedded within text

data. This analysis is conducted to discern the tendency (polarity) of public opinion on a particular issue or object, determining whether the sentiment leans towards positive or negative (Dehaff, 2010). Several studies have employed sentiment analysis and text mining, such as Ainin et al. (2020) on halal tourism and halal cosmetics, and Rusydiana et al. (2018) on sentiments towards micro-Takaful and waqf.

Large Language Models (LLMs) have demonstrated substantial promise in various natural language processing (NLP) tasks, including sentiment analysis. LLMs are trained on vast datasets encompassing a wide range of texts, enabling them to understand and generate human-like text. Their ability to perform sentiment analysis stems from their deep neural network architectures, which can capture complex linguistic patterns and contextual nuances (Brown et al., 2020).

The lexicon-based approach in sentiment analysis involves utilizing a predefined list of words associated with specific sentiments. LLMs enhance this approach by comprehending the context in which these words are used, thereby improving the accuracy of sentiment classification. This method contrasts with traditional sentiment analysis techniques that often rely on simpler bag-of-words models or manually curated sentiment lexicons (Hota et al., 2021).

Incorporating LLMs in sentiment analysis allows for more sophisticated and nuanced interpretations of text data. These models can handle idiomatic expressions, sarcasm, and context-dependent sentiment shifts, which pose challenges for conventional models. By leveraging APIs for LLMs, researchers can automate and scale the sentiment analysis process, applying it to large datasets efficiently (Radford et al., 2019).

The use of the LLM method with a lexicon-based approach enables automatic text analysis, identification of sentiment polarity (positive, negative, or neutral) (Kaul & Sharma, 2023), as well as data science techniques used for data processing, cleaning, and visualization, enabling accurate and precise interpretation of model results.

Sentiment analysis, powered by advanced Natural Language Processing (NLP) techniques, has emerged as a valuable tool for gauging public opinion on policy matters. By analyzing large volumes of text data from news sources and social media, researchers can gain insights into public perception that traditional surveys might miss. This approach is particularly relevant in the context of halal certification, where public opinion can significantly influence both consumer behavior and policy effectiveness (Alam et al., 2021).

The present study aims to analyze public sentiment towards mandatory halal certification in Indonesia using a Large Language Model (LLM) approach. By examining a dataset of news headlines from various electronic media platforms published between 2019 and 2023, this research seeks to provide insights into the public perception of the new halal certification regulations.

The findings of this study will contribute to the understanding of public sentiment towards regulatory changes in the halal industry and offer valuable insights for policymakers and businesses in addressing potential challenges.

Furthermore, this research demonstrates the application of advanced NLP techniques in policy-related sentiment analysis, showcasing the potential of LLMs in comprehending nuanced opinions and sentiments expressed in text data. The results of this study will not only inform the ongoing implementation of halal certification policies in Indonesia but also provide a methodological framework for similar studies in other contexts where religious, economic, and regulatory factors intersect.

Method

The entire analysis and modeling process in this research was conducted using Python programming language version 3.12.3 with other supporting libraries. The data used were secondary data obtained from various electronic news media during the period of 2019 to 2023. Data collection was carried out using the web scraping method with the BeautifulSoup4 (BS4) and Selenium libraries, and the information extracted was news headlines that were relevant to the halal industry in Indonesia. The web scraping process targeted major Indonesian news outlets, including but not limited to *detikcom*, *cnnindonesia*, *cnbcindonesia*, *antaranews*, and *bpjph*. This diverse range of sources was chosen to ensure a comprehensive representation of public discourse on halal certification.

Data Filtering and Cleaning

Subsequently, a data filtering process was performed using the Pandas, Natural Language Processing (NLP) and Regular Expression (RegEx) libraries to focus the data on the halal industry object. Data cleansing was carried out by removing duplicate news using the Term Frequency-Inverse Document Frequency (TF-IDF) technique and cosine similarities to reduce bias in results caused by vector similarity from news headlines that may have the same context.

TF-IDF and cosine similarity were chosen for their effectiveness in identifying and removing duplicate or near-duplicate content. TF-IDF helps in

determining the importance of words in a document relative to a collection of documents, while cosine similarity measures the similarity between two text documents irrespective of their size. These techniques improve the dataset's quality by ensuring that each piece of news represents a unique perspective, reducing bias that could arise from overrepresentation of similar news items.

For example, the news headline "mie gacoan tak bisa disertifikasi halal ini sebabnya" has a similarity with "mie gacoan tak bisa disertifikasi halal ini penjelasannya". According to TF-IDF and cosine similarity calculations, the vector context similarity is more than 75%.

Table 1.
Examples of news headlines before and after preprocessing and modeling

Before Data Preprocessing	After Data Preprocessing
Terungkap 2 Kendala Sertifikasi Halal UMKM	terungkap kendala sertifikasi halal umkm
Alasan Pemerintah Tunda Kewajiban Sertifikasi Halal Produk UMKM	alasan pemerintah tunda kewajiban sertifikasi halal produk umkm
Peraturan UMKM Wajib Sertifikasi Halal hingga 17 Oktober 2024 Ditunda	peraturan umkm wajib sertifikasi halal hingga oktober ditunda

Sentiment Analysis Model

Sentiment analysis was performed by utilizing the Application Programming Interface (API) in the Large Language Model (LLM), namely "indonesian-roberta-base-sentiment-classifier" which has been developed by Wongso (2023), a sentiment-text-classification model based on the RoBERTa architecture.

This model was fine-tuned on the *indonlu's SmSA* dataset, which consists of Indonesian comments and reviews. The model was trained using Hugging Face's Trainer class from the Transformers library, with *PyTorch* as the backend framework. And the application of the model is used to classify based on sentiment polarity in Indonesian text data, whether the tested text has a positive, negative, or neutral sentiment. The choice of this model was based on its superior performance in handling Indonesian language nuances and its ability to capture context-dependent sentiments.

With an evaluation accuracy of 94.36% and F1-macro of 92.42% during training. On the benchmark test set, it demonstrated an accuracy of 93.2% and F1-

macro of 91.02%, indicating high reliability in sentiment classification tasks for Indonesian text.

Data Analysis and Visualization

Following the sentiment classification, we conducted a temporal analysis to identify trends in public sentiment over the study period (2019-2023). This analysis aimed to reveal any shifts in public opinion that might correlate with key events or policy announcements related to halal certification.

The sentiment polarity analysis aims to identify public sentiment trends towards the halal industry over time, whether they tend to be positive, negative, or neutral with the implementation of new government regulations regarding halal certification. The data visualization process is carried out using the Matplotlib library so that the analysis results can be presented in a more intuitive and understandable manner.

Result and Discussion

This research analyzed a total of 320 news headline samples from various electronic news platforms (*detikcom*, *cnnindonesia*, *cnbcindonesia*, *antaranews*, and *bpjph*) that have been published from 2019 to 2023. The number of samples was determined based on consideration of word similarity using TF-IDF and focus on topics related to halal regulations.

Analysis of Sentiment

During this period, sentiment analysis was conducted, and the model results showed the distribution of sentiment polarity along with their confidence scores. Out of 320 samples, 182 positive sentiments, 83 negative sentiments, and 55 neutral sentiments were found. With a varying distribution of score levels depending on how confident the model stated the sentiment.

To illustrate the range of sentiments captured in our analysis, consider these following examples to demonstrate the nuanced nature of public discourse surrounding halal certification, with neutral analytical perspectives:

1. Positive sentiment: "selamat indonesia jadi destinasi wisata halal terbaik dunia" (Congratulations, Indonesia becomes the best halal tourism destination in the world). This headline reflects the positive reception of Indonesia's progress in the halal industry, specifically in tourism.
2. Negative sentiment: "bayangan gelap uang gendut sertifikasi produk halal" (The dark shadow of the hefty cost of halal product certification). This headline encapsulates the concerns about the financial burden of halal certification, particularly for smaller businesses.

3. Neutral sentiment: "rantai nilai halal sebagai terobosan ekonomi syariah" (Halal value chain as a breakthrough in sharia economics). This headline presents a balanced view, discussing halal certification in the context of economic development without expressing a strong positive or negative sentiment.

The model results (Table 2) show that the sentiment related to the new regulation of mandatory halal certification for entrepreneurs tends to be centered on positive sentiment with the confidence scores of the classifications had a mean of 87.35% with a standard deviation of 16.52%. The minimum confidence score was 40.31%, while the maximum was 99.94%. The median confidence score (50th percentile) was 96.12%, indicating that half of all classifications were made with over 96% confidence. However, it should be noted that the model's accuracy may vary depending on the data domain and the context of the sentences being analyzed.

Table 2.
Examples of News Headlines from Sentiment Analysis Using the LLM Model

News Headline	Sentiment	Score
selamat indonesia jadi destinasi wisata halal terbaik dunia	Positive	99.49%
rantai nilai halal sebagai terobosan ekonomi syariah	Positive	93.86%
menag optimistis produk halal indonesia mampu tembus pasar jepang	Positive	99.59%
produk makanan hewan sembelihan belum bersertifikat halal di siap siap kena sanksi	Negative	98.23%
bayangan gelap uang gendut sertifikasi produk halal	Negative	54.89%

These performance metrics suggest a high degree of reliability in our sentiment classifications. The high mean and median confidence scores (87.35% and 96.12% respectively) indicate that the model was generally very certain about its classifications. However, the presence of lower confidence scores (minimum 40.31%) highlights the complexity of sentiment analysis in real-world text data. To address this, we implemented additional manual checks for classifications with confidence scores below 70%, ensuring the robustness of our analysis. These

results also in line with Yulia (2015) that the increasing public awareness towards the halal stigma, which is no longer limited to religious rules but has become a general standard for quality products, thus increasing the demand for halal products from both Muslim and non-Muslim consumers. And, this finding aligns with the Theory of Planned Behavior Ajzen (1991), which suggests that positive attitudes towards a behavior (in this case, halal certification) can lead to increased intention to perform that behavior. The high positive sentiment indicates a favorable attitude towards halal certification, which could translate into greater compliance and support for the new regulations.

Temporal Analysis of Sentiment

Since the enactment of Government Regulation (PP) No. 39 of 2021 concerning the Implementation of Halal Product Guarantee as a derivative of the Job Creation Law, news on halal topics has become more frequent on electronic news media sites. This regulation explains in detail the mandatory halal certification for SMEs, including the stages and deadlines. Based on the data, there was a significant increase in the number of news headlines on the topics of 'halal' and 'halal certification' in 2022 and 2023.

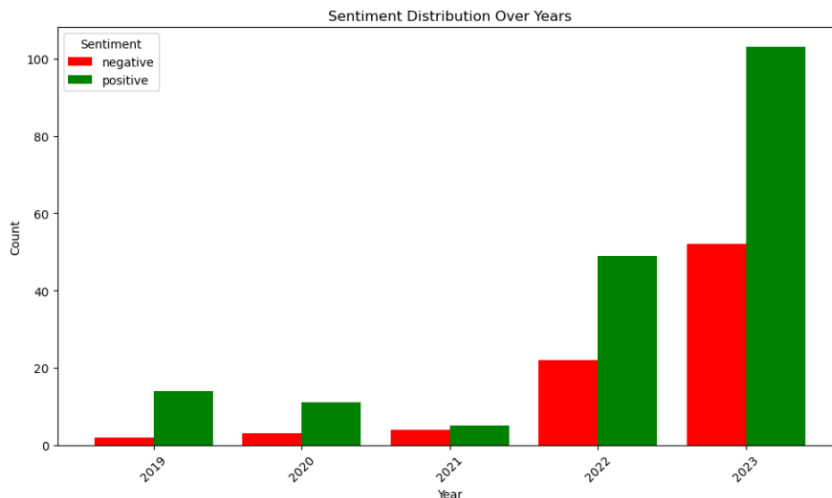


Figure 1.

Distribution of Sentiments Related to the "Halal" Issue Over Time

This trend (Figure 1) is consistent with the findings of Mostafa (2020), who observed an increasing public interest in halal certification over time, particularly following regulatory changes. The spike in news coverage reflects the growing importance of halal certification in public discourse and its potential impact on various stakeholders.

Halal certification has become an increasingly important issue in the food and other consumer product industries. The regulation aims to protect Muslim consumers and ensure the halal status of circulating products. However, on the other hand, the mandatory halal certification has also become a challenge for SMEs, especially in terms of costs and processes that must be undertaken. (Charity, 2017)

The challenges faced by SMEs can be analyzed through the Resource-Based View of the firm (Barney, 1991). Smaller firms often lack the financial and human resources necessary to navigate complex certification processes, putting them at a disadvantage compared to larger competitors. This theoretical perspective helps explain why SMEs might struggle with the implementation of mandatory halal certification despite recognizing its importance.

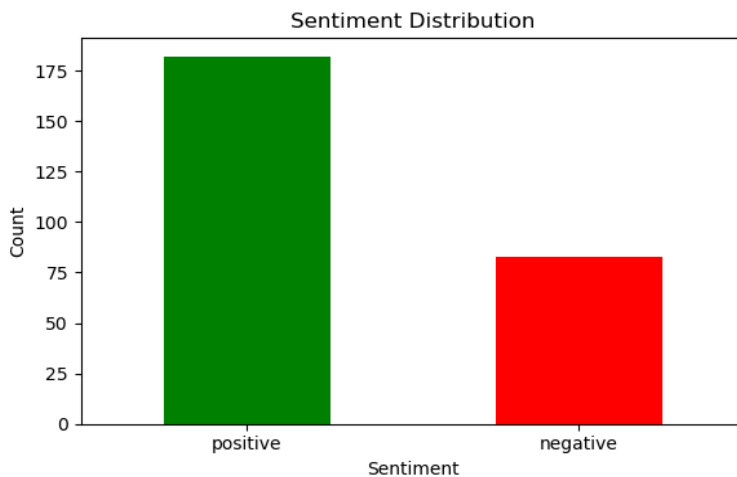


Figure 2.

Sentiments Distribution Related to the "Halal" Issue

Some news with negative sentiment highlighted the challenges faced by SMEs in obtaining halal certification, such as high costs, lack of understanding about the certification process, and the availability of adequate human resources. From the Figure 2, 26% negative sentiment was found. Despite these challenges, the dominant 57% positive sentiment indicates that the public and businesses understand the importance of halal certification in increasing consumer confidence and maintaining product quality. This predominant positive sentiment aligns with the concept of 'halal value chain' proposed by Tieman et al. (2012),

which emphasizes the role of halal certification in ensuring product integrity throughout the supply chain.

Implications of the Research Findings

The positive reception of Indonesia's progress in halal tourism suggests that investments in halal infrastructure and promotion are paying off. This aligns with findings by Mastercard-CrescentRating (2019), which ranked Indonesia as the top halal tourism destination globally. But the concerns about the financial burden of halal certification highlight the need for supportive policies. This echoes recommendations by Abu Talib et al. (2017) for governments to provide financial incentives and technical support for halal certification.

The positive sentiment indicates a growing market opportunity. As noted by Basri and Kurniawati (2019), companies in the tourism and hospitality sectors could capitalize on this by obtaining halal certification and marketing their services to halal-conscious travelers. But larger companies could view this as an opportunity to differentiate themselves but should also consider supporting their supply chain partners (Tieman, 2014).

To illustrate the challenges faced by SMEs in obtaining halal certification, small family-owned restaurants often find certification fees represent a significant portion of their revenue. This aligns with findings by Salindal (2019), who identified financial constraints as a primary challenge for SMEs in halal certification. In addition, small producers often struggle with the detailed documentation required for halal certification. This challenge is consistent with research by Muhamed et al. (2019), who found that lack of expertise in halal requirements was a significant barrier for SMEs.

Furthermore, through the lens of Signaling Theory (Spence, 1973), halal certification can be seen as a signal of quality and compliance, reducing information asymmetry between producers and consumers. As Annabi and Ibdapo-Obe (2017) noted, halal certification serves as a trust mark, especially in markets where consumers may have limited ability to verify product compliance with Islamic principles. These SMEs understand the importance of halal certification as a quality signal to consumers. However, as argued by Verbeke et al. (2013), the challenges they face in obtaining this signal put them at a competitive disadvantage compared to larger firms that can more easily absorb the costs and complexities of certification.

Policy implications in this research include: Policy support for SMEs is required to develop targeted assistance programs to help SMEs navigate the halal certification process, potentially including financial assistance, technical support,

and simplified procedures for small businesses; A phased implementation of the mandatory certification requirements is important, allowing more space for companies, especially SMEs, to adapt and comply with the requirements; A comprehensive awareness campaign to educate businesses and consumers on the benefits and process of halal certification should be launched to address misconceptions and build confidence; A collaborative approach to foster partnerships between large companies, SMEs and certification agencies is essential to enable knowledge and resource sharing and facilitate a more inclusive halal ecosystem; International Benchmarking is encouraged to study successful halal certification models from other countries to adopt best practices and improve Indonesia's global competitiveness in the halal market.

Limitation

A limitation of the analysis used in this study is that while news headlines provide valuable insights into public discourse, they may not fully capture the nuanced opinions of individuals or specific stakeholder groups. In addition, the reliance on online news sources may introduce a bias towards more digitally connected segments of the population. Additionally in this research, the sentiment classification results from the model were also manually validated to ensure accuracy and minimize classification errors. The use of a state-of-the-art LLM model, coupled with comprehensive data collection and rigorous validation, provides a solid foundation for understanding the complex landscape of public opinion on this important issue.

While the use of LLMs for sentiment analysis offers powerful insights, it also raises ethical considerations. The application of AI in analyzing public opinion on policy matters requires careful attention to potential biases in the model and the data. The sentiment analysis may not capture the full complexity of individual opinions and that the results should be interpreted as broad trends rather than definitive individual stances. The use of publicly available news headlines, while not requiring individual consent, still necessitates responsible reporting to avoid misrepresentation.

Conclusion

This study analyzed public sentiment towards mandatory halal certification in Indonesia using a Large Language Model approach on 320 news headlines from 2019 to 2023. The findings reveal a predominantly positive sentiment (57%)

towards halal certification, indicating general acceptance and understanding of its importance. The model demonstrated a confidence score of the classifications mean of 87.35% and median 96.12% with 16.52% standard deviation in classifying the news headlines demonstrates the potential of LLM-based approaches in gauging public opinion on regulatory issues. While overall sentiment is positive, the study also uncovered challenges, particularly for SMEs, with 26% negative sentiments primarily concerning certification costs and process complexities. These findings underscore the need for balanced policy implementation that considers the diverse capabilities of different business sectors. The research contributes to understanding public perception towards halal industry regulations and provides insights for policymakers and businesses. It showcases the effectiveness of advanced NLP techniques in analyzing public sentiment on policy matters.

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